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AGRICULTURAL MEMORANDUM NO 554

An annotated bibliography on the effects of mulching on plant climate, with some comments on consequent yields.

Part V - Effects on Pests and Diseases

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Parts I, II, III and IV of this bibliography were issued as Agricultural Memoranda Nos 392, 423, 523 and 548.

5.1 NO SPECIFIC CROP

Damage to crops from sawdust mulches may be caused by N starvation or an increase of termite population, but it is chiefly due to poisons used to preserve the timber before conversion to sawdust, according to Chippendale (1).

1. CHIPPENDALE F. 1954. Use sawdust with care. Qd. agric. J. 78 (4), 199-200

5.2 TEMPERATE TREE FRUITS

Where it is advisable to grow cherry trees in sod to control erosion in the USA, Gilbert (1) states that a heavy mulch should also be used to prevent the spread of cherry leaf yellows. However Fisher (3), also in USA, shows that straw mulching increased the development of fire blight, which was greatest in the areas of poorest soil drainage. Meanwhile Shibukawa (2) reports from Japan that sod culture may increase damage by peach fruit moth, apple mealy bug and mice.

Lavee (4) presents the results of a field survey in Israel which shows that apple trees grown with clean cultivation were much more susceptible to infection by the root rot fungus, Sclerotium rolfsii than were trees grown with cover crops or a weed cover. Mortality of the plants due to S. rolfsii on the mulched plots was half that on unmulched plots. On artificially heated, mulched plots, however, mortality was similar to that on the unmulched, unheated controls, indicating that the increase in resistance on the mulched plots was dependent on temperature. The reduction in soil temperature was shown to increase the bark content of oxidisable polyphenols, which appeared to be associated with resistance to the fungus.

The effect of a mulch of polyethylene film on apple trees has been studied by Miller (5). He found that black film, resulting in moderate soil temperatures, caused the fungus, Rhizoctonia solani to increase, accompanied by a marked decrease in the nematode, (Pratylenchus penetrans) population. The same did not happen in the warmer soil under transparent film. Though lower soil temperatures under a hay mulch increased R. solani, there was no decrease in the nematode populations, possibly due to the failure of hay to encourage predaceous fungi.

1. GILBERT F. 1955. Is it best to cultivate or mulch the cherry trees? Wis. Hort., 45, 288

2. SHIBUKAWA J. 1955. Sod culture for increasing productivity of apples. (in Japanese). Aomori Apple Ass. Ser. 29, 36 pp

3. FISHER E G and others. 1959. The influence of phosphorus, potassium, mulch, and soil drainage on fruit size, yield, and firmness of the Bartlett pear and on development of the fire blight disease. Proc. Amer. Soc. hort. Sci., 73 : 78-90, 4 refs

4. LAVEE S. 1963. The effect of mulch on the resistance of E.M.-II apple stock to Sclerotium rolfsii (Sacc). Proc. Amer. Soc. hort. Sci 82: 25-34, 15 refs

5. MILLER P M and WAGGONER P E. 1963. Interaction of plastic mulch, pesticides and fungi in the control of soil-borne nematodes. Plant and Soil, 18: 45-52, 10 refs

5.3 TEMPERATE HORTICULTURE AND SOFT FRUIT, VEGETABLES AND FLOWERS

Douglas-fir sawdust, used as a mulch, caused a significant increase in the incidence of red-core of strawberry caused by the fungus, Phytophthora fragariae, according to Vaughan (1). Similar amounts of sawdust incorporated with the soil caused only a slight increase in the incidence of the disease. The increased development of red-core was apparently brought about by a decrease in soil temperature and an increase in the moisture content of the mulched soil.

A mulch of polyethylene sheeting was used by Huffman (2) which considerably reduced losses of strawberries due to fruit rot, while Hilborn (4) used a similar mulch to keep lettuce heads out of contact with the soil and hence to reduce slime rot (caused by Pseudomonas sp) from 52.7% to 16.3% with a white film and 18.2% with a black film.

Avidov (3) practically eliminated the infestation of tomato seed-beds in Israel by tobacco white fly (Bemisia tabaci) by applying a sawdust mulch, which raised the surface temperature above 46°C which is lethal to the adults. Irizarry (12) however, reports that the use of a black polythene mulch did not have any marked effect in reducing the incidence of soil fruit rot of tomatoes in Puerto Rico, while Brandenburg (7) also claims that mulching with black plastic was unsuccessful; it effectively suppressed regrowth but created a warm moist environment around the roots of parsnips which encouraged the incidence of canker (mainly Itersonilia perplexans).

The cause of raspberry cane die-back is considered by Fritzsche (5) to be physiological, mainly adverse soil moisture conditions and the application of a straw mulch, which reduced variations in soil moisture, resulted in less bark splitting and therefore less secondary infection.

Dickson (8) used strips of heavy aluminium foil fastened above melon plants in two separate areas of a field in California to repel water-melon mosaic virus vectors to some extent and to delay infection by 5 to 10 days. Little or no protection extended to beds adjacent to those protected by the foil. Messiaen (11) meanwhile reports on similar trials with melons in France. Transparent plastic strips had little effect on the incidence of cucumber mosaic virus, but with broad strips of silver painted plastic, the incidence of disease 6 weeks after planting was below 8% compared with 60% in unmulched plots. A compromise soil cover is suggested, consisting of transparent plastic sprayed with enough paint droplets to cover half its surface.

A ground cover of aluminium foil around yellow straight-neck squash showed a significant retarding effect upon aphid and leaf miner populations and virus disease was appreciably reduced according to Moore (9) in Florida. Similar results were found

in Maryland (10) and also in Virginia where Sacharow (13) reports that squash plants mulched with aluminium foil developed only 4% mosaic compared with 51% on black polythene mulched plots and 68% on the unmulched controls. Further studies indicated that coloured coatings on the foil drastically reduced its inherent aphid repelling character.

1. VAUGHAN E K, ROBERTS A N and MELLENTHIN W M. 1954. The influence of Douglas fir sawdust and certain fertilizer elements on the incidence of red-stele disease of strawberry. Phytopathology, 44, 601-3, 3 refs

2. HUFFMAN J W. 1955. Plastic mulch reduces strawberry fruit rot. Market Grs. J. 84 (11), 9

3. AVIDOV Z. 1956. Bionomics of the tobacco white fly (Bemisia tabaci Gennad) in Israel. Ktavim, 7: 25-41, 7 refs

4. HILBORN M T, HEPLER P R and COOPER G F. 1957. Effect of polyethylene mulch on soil-borne pathogens of lettuce. Phytopathology, 47, 245

5. FRITZSCHE R. 1958. Contribution to the aetiology of raspberry cane die-back. (in German). Arch. Gartenb., 6: 171-216, 41 refs

6. GOSS O M. 1961. The relationship of root lesion nematodes to premature decline and die-back of apples and replant difficulties in Western Australia. Proc. Plant Path. Conf. Waite agric. Res. Inst., Adelaide, 1961, Vol 1, Article No 36, 2 pp

7. BRANDENBURG W. 1965. Control of parsnip canker disease in Canterbury. NZ comm. Gr. 20(10): 13, 15, 19

8. DICKSON R C and LAIRD E F, Jr. 1966. Aluminium foil to protect melons from water-melon mosaic virus. Plant. Dis. Reptr. 50: 305

9. MOORE W D and others. 1966. Reduction of aphid populations and delayed incidence of virus infection on yellow straight neck squash by the use of aluminium foil. Proc. Fla. St. hort. Soc. 1965, 78: 187-91, 7 refs

10. - - 1966. Aluminium repels aphids. Int. Pest. Control, 8 (1): 5

11. MESSIAEN C-M, and others. 1965. Trials on the protection of melon crops against cucumber mosaic virus. Beneficial effects of mulching with reflecting plastic films. (in French). C.R. Acad. Agric. Fr. 53: 103-8, 3 refs

12. IRIZARRY H, AZZAM H and WOODBURY R. 1968. Evaluation of black polythene plastic mulch for tomato production in Puerto Rico. J. Agric. Univ. P.R., 52: 53-63, 7 refs

13. SACHAROW S. 1968. Foiling pests with foil. World Crops, 20(3): 43-4, 7 refs

5.4 FORESTRY

Macrophomima phaseoli, a fungus which causes stem rot of forest trees in the nursery,

is favoured by hot dry weather and Fang (1) has successfully controlled the disease in China by proper shading and the mulching of the seedbed during the critical period. Levisohn (2) reports work from England where the beneficial effects of mulching on tree development, include changes in quantity and/or quality of certain common root infections.

In Japan, Sato (5) found that mulching beds of coniferous seedlings with leaf litter or straw before the winter, encouraged snow-mould, especially leaf litter which resulted in 45.5% diseased compared with 18.2% for the control. Bloomberg (6) however, reports cases of fungus disease possibly introduced into nursery beds by the use of organic mulches to prevent frost heaving. Of the substances used, fresh sawdust from sound conifers seems to be the safest as it yielded fewer than half the number of fungus colonies that wheat straw did when plated on malt agar. The sawdust is believed to restrict the growth of pathogenic fungi whereas straw may be pathogenic in some conditions.

Van Nierop (3) found that mulches of rapidly decomposing sawdust caused an increase in earthworm and nematode populations, more than did wood chips or peat mulches. Cozzo (7) describes the use of squares 40 x 40 and 60 x 60 cm of felt, black polythene or kraft paper as mulches around recently planted forest trees in Argentina. They were too small to give adequate control of the dense weed growth in which leaf-cutter ants proliferated. Pruett (4) alsoclaims that mulching can be detrimental around newly planted trees. Sawdust applied at 0.04 m^3 per plant spread in a 1 m circle created openings in the surrounding rank weed growth and greatly increased damage by rabbits, particularly to Norway Spruce, Green Ash, Red Oak and Yellow Poplar.

1. FANG C-T and others. 1956. Experiments on the control of the stem rot disease of Ginkgo caused by Macrophomina phaseoli. (in Chinese). Acta Phytopath. Sin. 2(1), 43-54

2. LEVISOHN I. 1957. Researches on mycorrhiza. Rep. For. Res. For. Comm., Lond. 1956/57, 86-91

3. VAN NIEROP E T and WHITE D P. 1958. Evaluation of several organic mulching materials on a sandy loam forest nursery soil. J. For. 56(1): 23-7, 10 refs

4. PRUETT E. 1959. Mulch around newly planted trees can be detrimental. Sta. Note Cent. St. For. Exp. Sta. No.132, 2 pp

5. SATO K, OTA N and SHOJI T. 1959. Effect of the covering of several coniferous seedlings with mulches in autumn on the outbreak of snow moulding. (in Japanese). J. Jap. For. Soc. 41(1), 32-4, 4 refs

6. BLOOMBERG W J. 1963. Use of organic residues in forest nurseries. Bi-m. Progr. Rep. For. Ent. Path. Br. Dep. For. Can. 19(6), 4

7. COZZO D. 1967. Mulching round recently planted forest trees. (in Spanish). Rev. for. Argent. 11(3), 79-83, 2 refs

5.5 GRASSES AND CEREALS

Mulch tillage, using a mulch planter, was compared with conventional seedbed preparation in a 4 year trial by Peterson (1). Among other effects, he reports that rodents and pheasants caused more damage to maize on mulched than on ploughed land.

1. PETERSON A E and ENGELBERT L E. 1959. Growing corn in Wisconsin without ploughing. Trans. Wis. Acad. Sci. 48, 135-40, 5 refs

5.6 TROPICAL AND SUB-TROPICAL CROPS

Trash mulching has reduced the incidence of stem borer (Chilotraea infuscatella) attack in a ratoon crop of sugarcane in both India and Pakistan (Parthasarathy (2) and Gill (5)).

Die-back of coffee in India is shown by Ananth (4) to respond to remedial measures which include adequate mulching to preserve soil moisture, whereas Crowe (6) attributes an increased incidence of coffee leaf miners (Leucoptera meyricki) in Kenya to an increase in mulching.

In experiments in Rhodesia to control anthracnose disease on tobacco, Cole (1) noted that when seedbeds were covered by light cloth for shade, they suffered greater damage from the disease than when a thin grass mulch was used. Yoshida (3) found that the populations of the mealy bug in citrus orchards were much lower under a straw mulch than in non-mulched soils.

1. COLE J S. 1957. Some control measures for anthracnose disease of tobacco. Ann. appl. Biol., 45: 542-9, 13 refs

2. PARTHASARATHY S V. 1959. Control of stem borer through trash mulching. Indian J. Sugarcane Res., 3, 151-2

3. YOSHIDA M, KUBOTA Y and SUZUKI Y. 1959. Studies on breeding and control methods of citrus ground mealy bug, Rhizoecus kondonis Kuwana. (in Japanese). J. hort. Ass. Japan, 28, 76-80, 9 refs

4. ANANTH K C and others. 1960. Die-back of coffee - outlook & observations. Indian Coffee, 24, 238-45, 14 refs

5. GILL M S. 1963. Effect of trash mulch on the growth and yield of ratoon crop of sugarcane. W. Pakist. J. agric. Res., 1(2), 149-56, 11 refs

6. CROWE T J. 1964. Coffee leaf miners in Kenya. I. Species and life history. II. Causes of outbreaks. III. Control measures. Kenya Coffee 29: 173-83, 7 refs; 223-31, 11 refs; 261-73, 11 refs

Any comments or suggestions on this paper should be sent to the author.

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